The Energy-Water Nexus at DOE
2016 NETL Water Management Program Workshop

November 30, 2016

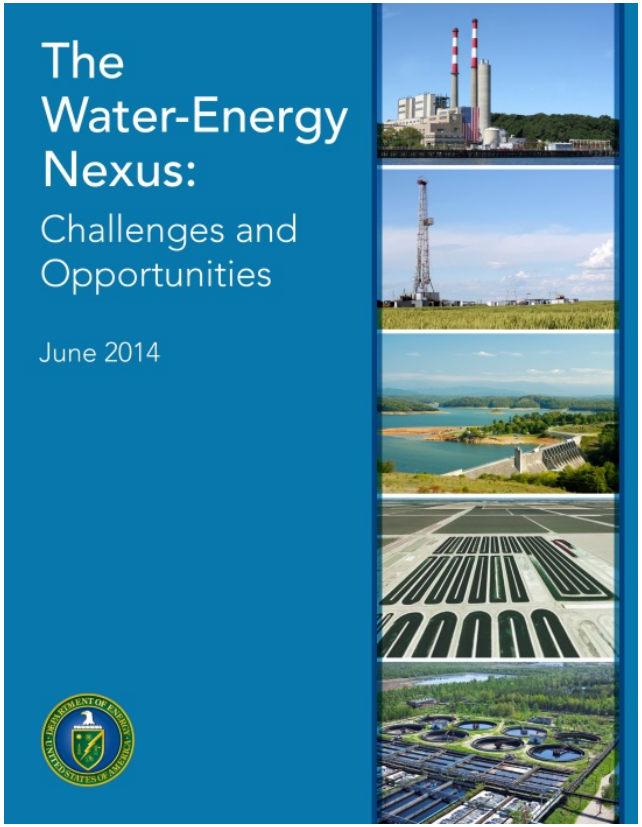
Zachary Clement
Office of Energy Policy and Systems Analysis
Department of Energy

Energy-Water Nexus: DOE's Role

- DOE has strong expertise in technology, modeling, analysis, and data and can contribute to understanding the issues and pursuing solutions across the entire nexus.

- Our work has broad and deep implications
  - User-driven analytic tools for national decision-making supporting energy resilience with initial focus on the water-energy nexus
  - Solutions through technology RDD&D, policy analysis, and stakeholder engagement

- We can approach the diffuse water area strongly from the energy side
  - Focus on our technical strengths and mission
  - Leverage strategic interagency connections



Download the full report at
energy.gov

Secretary's Energy-Water Roundtable Series (2015)

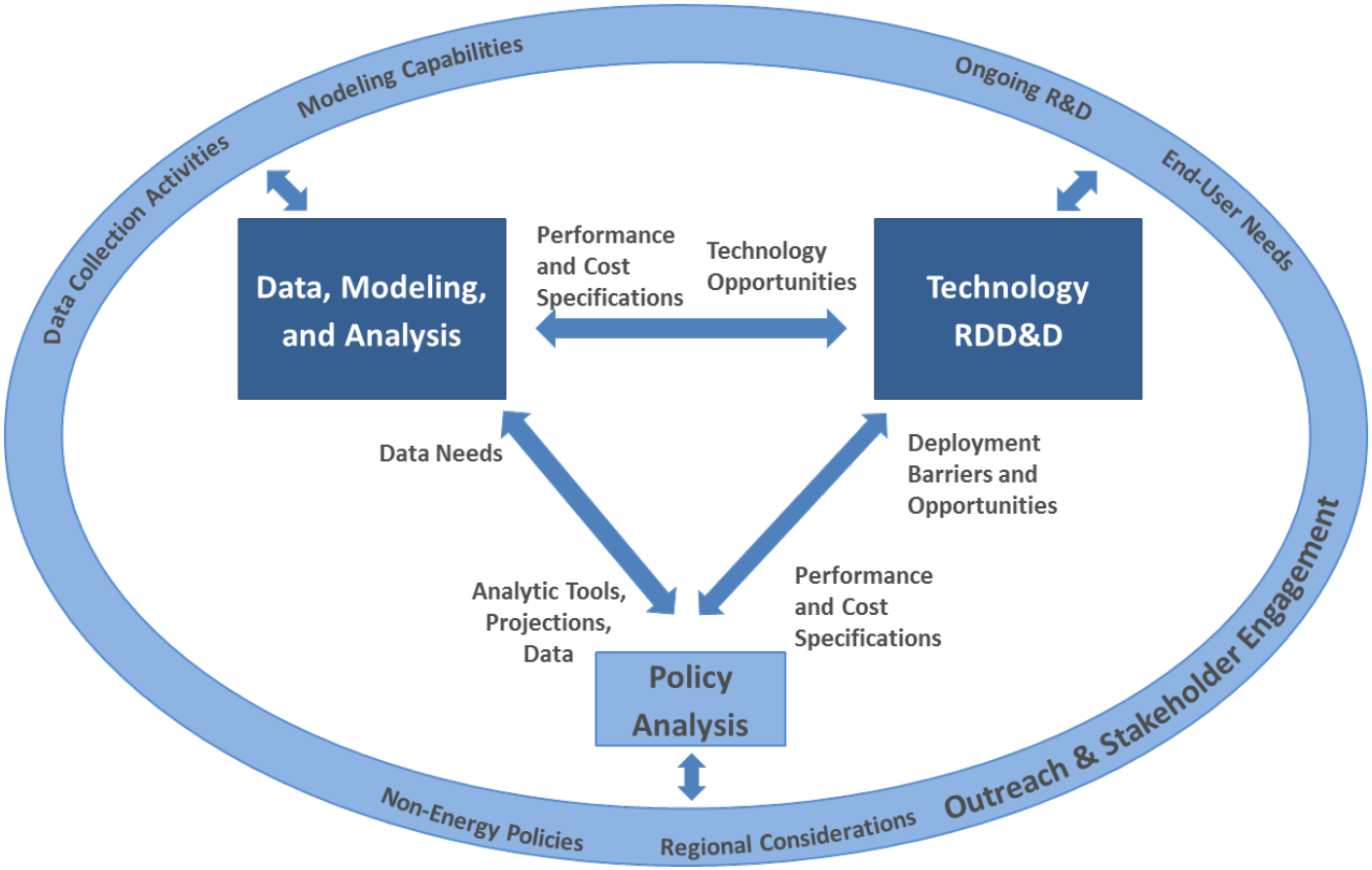
- 6 Roundtables:
  - Opening, Fuels, Water Infrastructure, Electricity, Systems Integration, Capstone
- Key Takeaways:
  - **Climate Change**: Designers of energy technologies, policies, and systems should be cognizant of interconnection among energy, water, and climate.
  - **Energy Security**: Energy systems must mitigate risk related to water resource scarcity and variability.
  - **Life Cycle Environmental Responsibility**: Environmentally responsible energy technology and policy development should be informed by lifecycle and systemic understanding.
  - **Systems Complexity and Systems Change**: Understanding change in energy and water systems is required for forward-looking technology investment and policy thinking.
- Next Steps:
  - Support Priority **Technology RDD&D**
  - Build a **Data, Modeling, and Analysis** Platform to Improve Understanding and Inform Decision-Making For a Broad Range of Users
  - **Engage States** to Advance Innovative, Integrated **Policy** Designs at Multiple Scales
  - Pursue **Innovative Finance Models** to Leverage Opportunities across Multiple Sectors
  - Pursue **Bilateral International Collaboration** to Solve Shared Challenges at the Energy-Water Nexus

U.S.-China Clean Energy Research Center: New Energy and Water Track

- Energy & Water US China Clean Energy Research Center (CERC) topic areas:
  - Water use reduction at thermoelectric plants
  - Treatment and management of non-traditional waters
  - Improving sustainable hydropower design and operation
  - Climate impact modeling, methods, and scenarios to support improved energy and water systems understanding
  - Data and analysis to inform planning, policy, and other decisions
- CERC Goals:
  - Spur Innovation of Clean Energy Technologies
  - Diversify Sources of Energy Supply
  - Improve Energy Efficiency
  - Accelerate Transition to Low-Carbon Future
  - Avoid the Worst Consequences of Climate Change
- DOE CERC domestic energy-water $2.5 million annual investment align with and are part of the larger energy-water crosscut strategy

In Nov 2014, Presidents Obama and Xi Jinping announced extension of CERC from 2016 to 2020 and expanded scope to include water related aspects of energy production and use.

Energy-Water Nexus Work Areas



Responding to Challenges in the Energy-Water System

Energy Technology Pathways

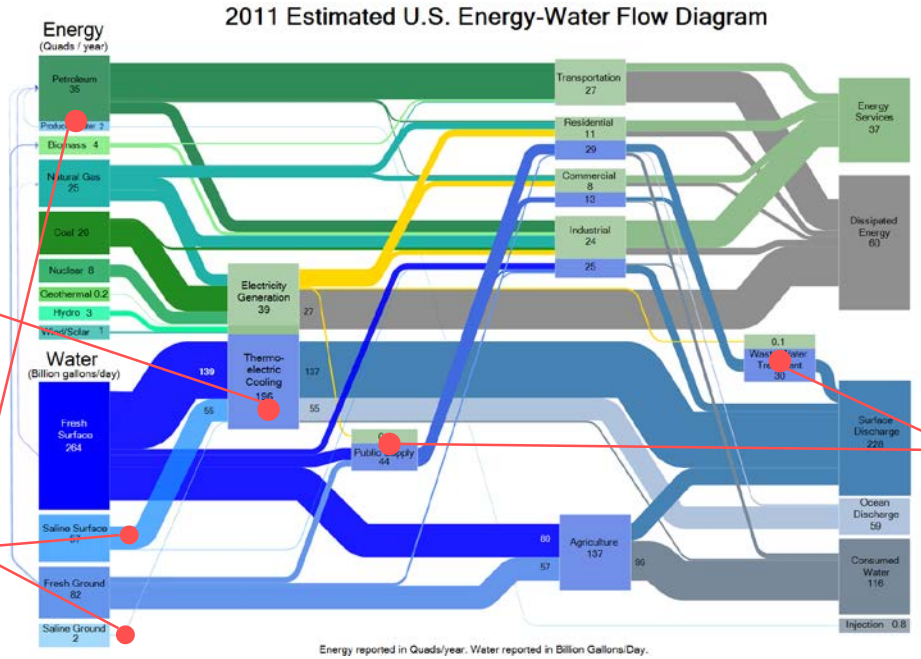
Forces on System

Climate Change (Mitigation and Adaptation)

Technology Solutions

Water-Efficient Cooling

Energy-Optimized Treatment, Management, and Beneficial Use of Nontraditional Waters



Sustainable Low-Energy Water Utilities

Policy and Institutional Changes

Land Use & Land Cover Change

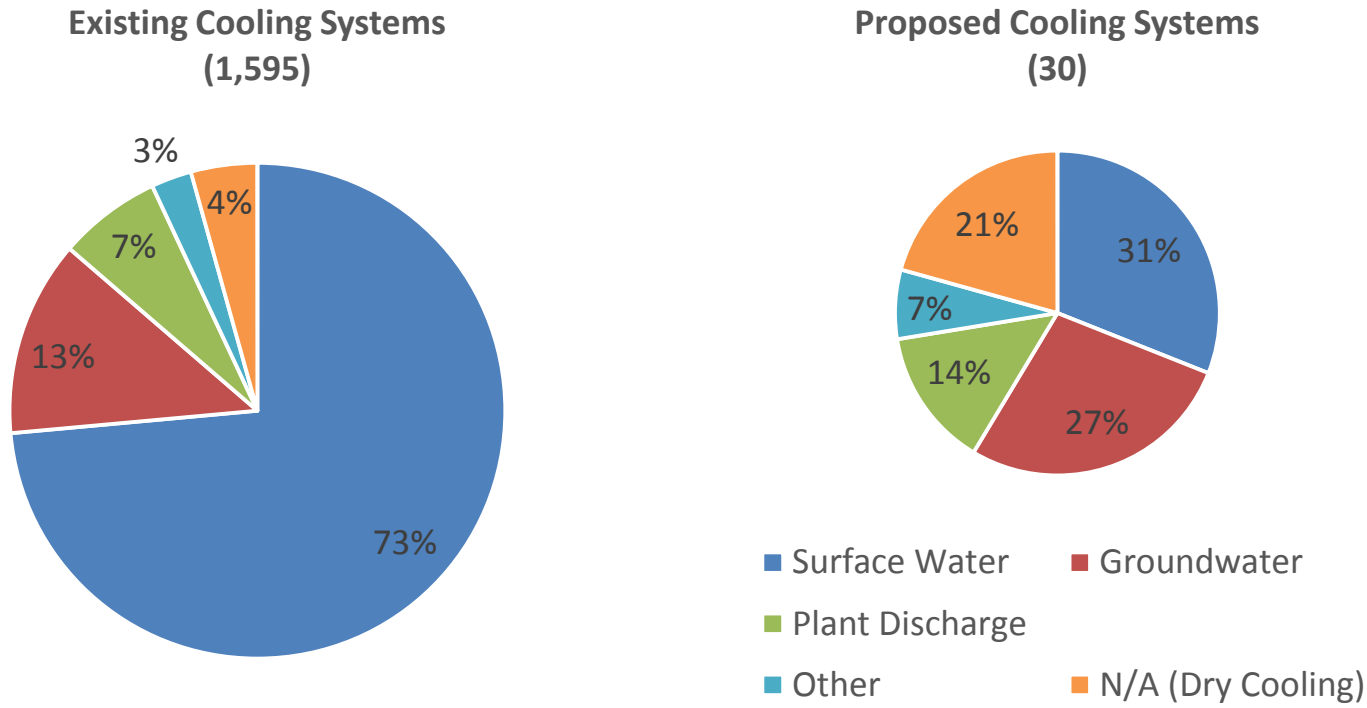
Stakeholder and Consumer Preferences

Population/ Migration

Urbanization & Infrastructure Dynamics

Regional Economic Development

U.S. Power Sector is Responding With Increased Utilization of Dry Cooling and Nontraditional Water



Data Source: EIA (2015)

However…

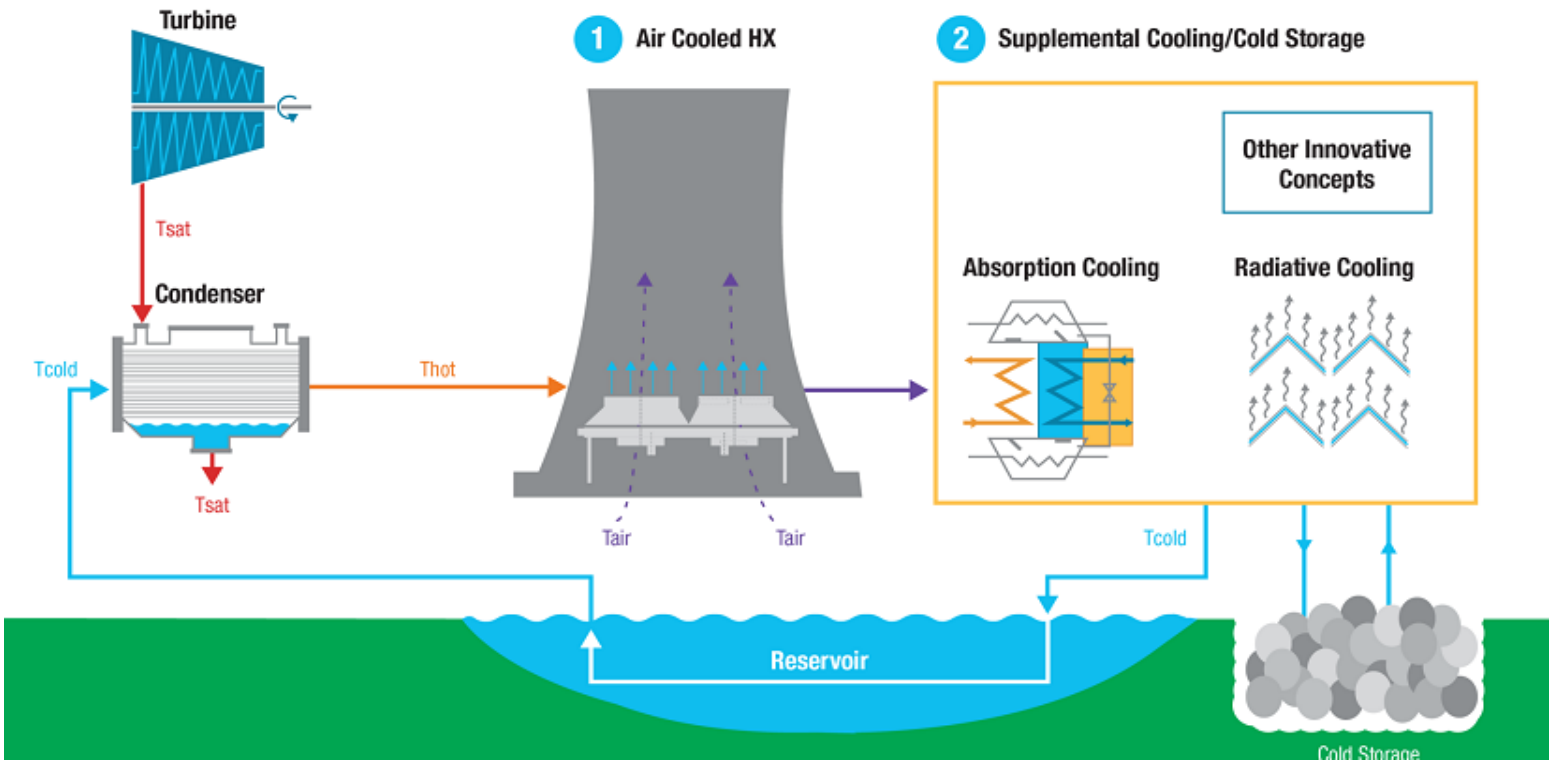
- Current dry cooling technologies are more expensive and come with efficiency penalties (and associated higher emissions).
- Using nontraditional water usually means more electricity for pumping and treatment (and associated higher emissions).

Dry Cooling for Electricity Generation

ARPA-E's Advanced Research in Dry Cooling (ARID) Research Solicitation is funding 14 projects for a total of $30 million:

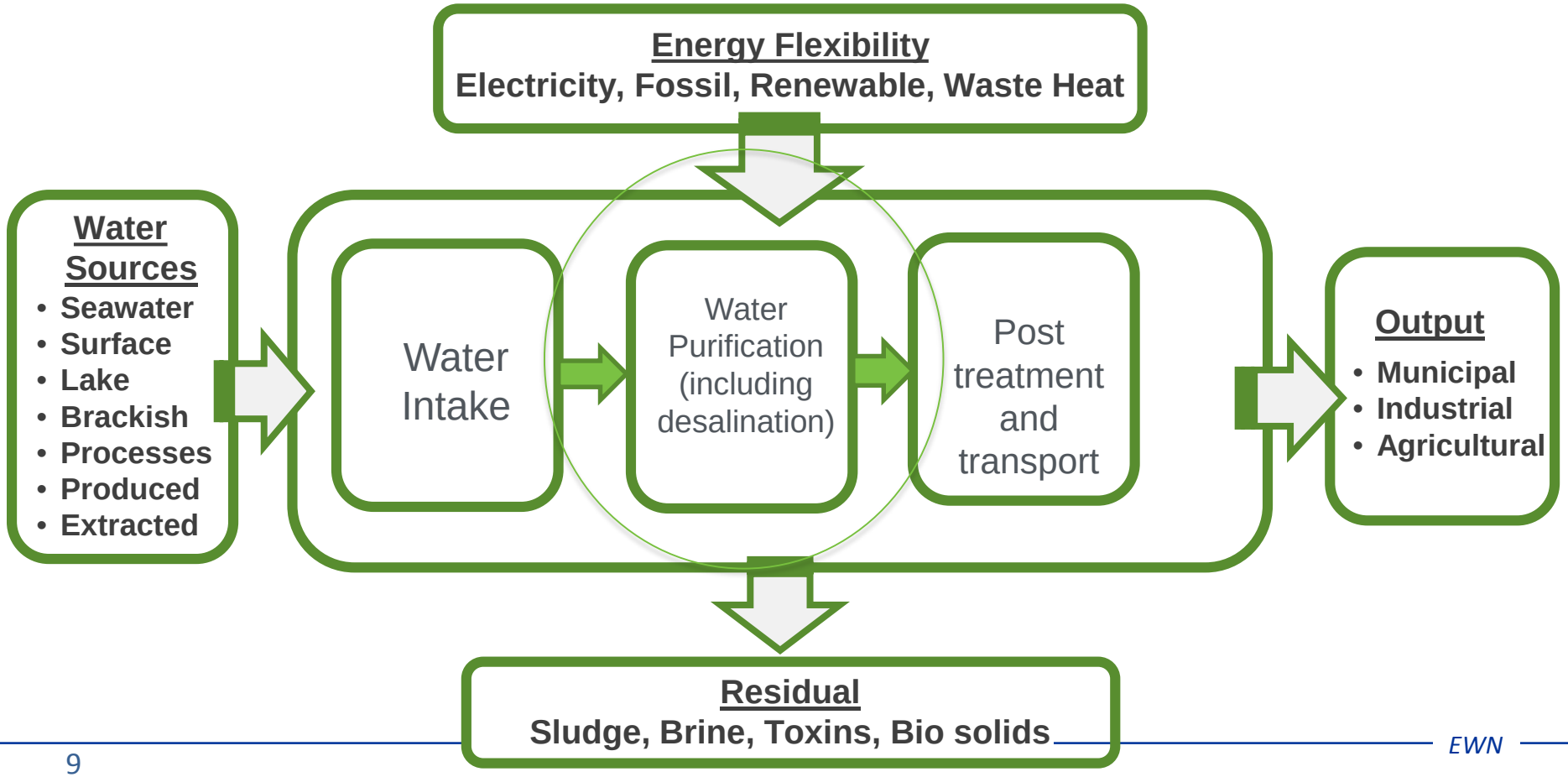
- Air-cooling heat exchangers (3 projects)
- Sorption & other supplemental cooling (4 projects)
- Radiative cooling and cool storage (3 projects)
- Flue gas H_2O recovery & cool storage (2 projects)
- Combined ACC & cool storage (2 projects)

Sample Indirect Dry-Cooling System that Satisfies ARID Program Objectives

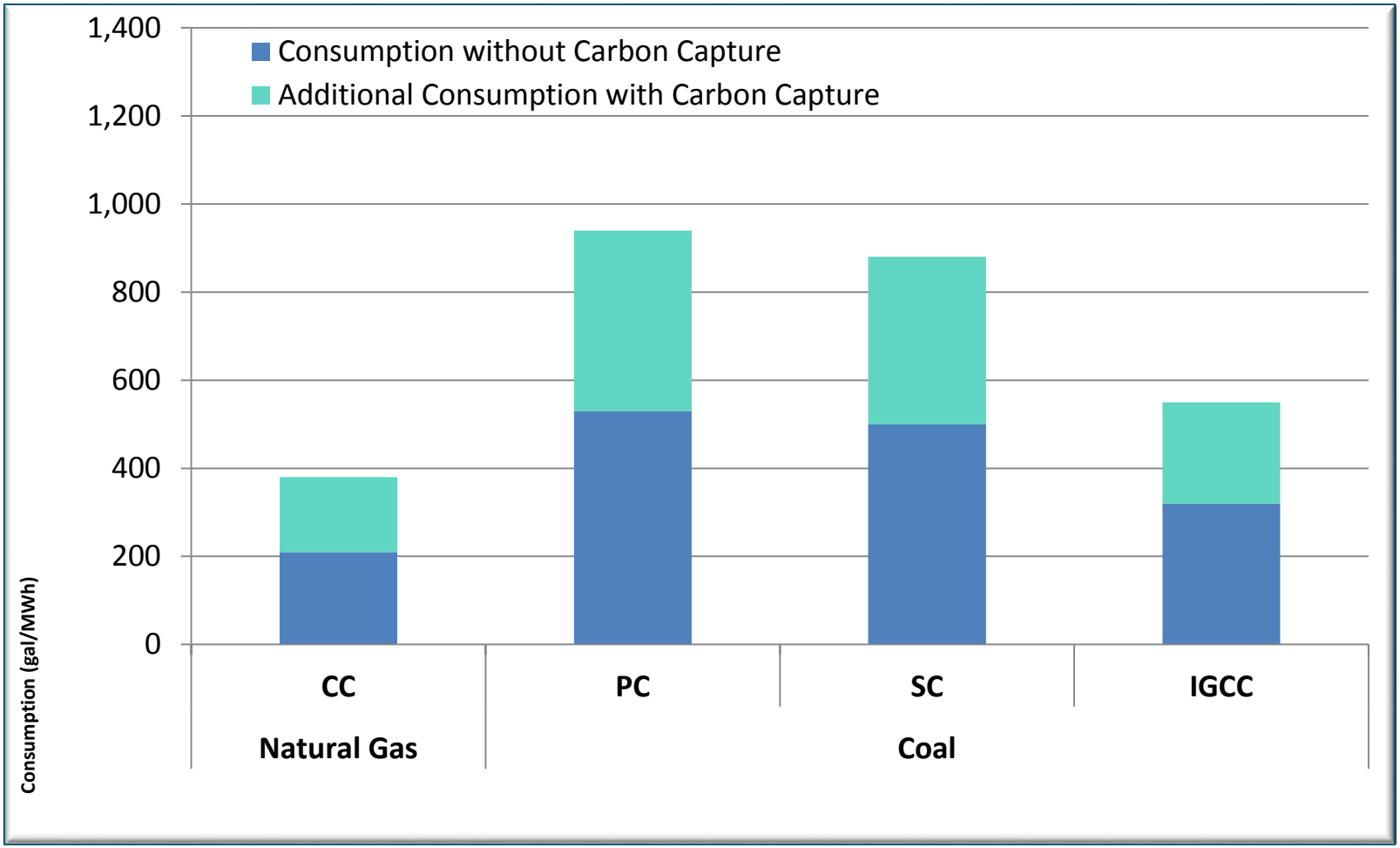


Clean Water Technologies

- Address manufacturing barriers to producing low-energy, cost-competitive clean water
- Technology priorities arise from facility-level systems-relevant challenges
- Leverage existing federal resources (e.g. DOI/Bureau of Reclamation testbeds)
- Request for Information to be issued soon



Carbon Capture Increases Water Intensity of Power



Capture technology: monoethanolamine

Source (DOE, 2014). Data Source: Meldrum et al. (2013)

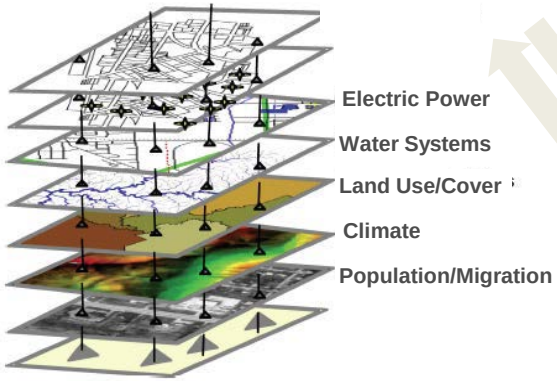
Data, Modeling, and Analysis Platform

National

D Layered Energy Resilience Data-Knowledge System

M Integrated Multi-System, Multi-Scale Modeling Framework and IAV Modeling

A Impact, Adaptation, and Vulnerability Strategic Research and Analysis



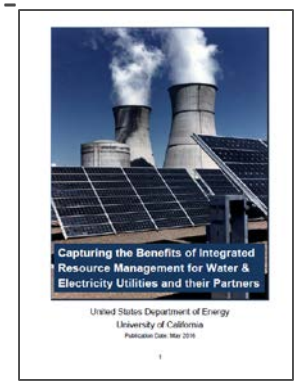
Regional

Regional-Scale Data, Modeling, and Analysis Test Beds

Sub-Regional

Energy and Water Systems Integration

- Capturing the Benefits of Integrated Resource Management for Water & Electricity Utilities and their Partners (Workshop with University of California-2015)
  - Convened utilities and policymakers in water and electricity
  - Identified opportunities in developing **shared systems understanding**; **data and analytics**; and **logistics and implementation** to make progress in GHG emissions reduction, resilience, and resource efficiency



- Integrated Desalination and Energy Design Competition with Israel (2016)
  - Competition for designs for novel integrated energy and **desalinization** systems that can:
    - **Flexibly interface** with the modern electric **grid**.
    - **Vary** their **operations** depending on current conditions.
    - Economically and flexibly **balance input and output** flows of water, electricity, and wastes.
- US-EU Collaboration on Power-Water Systems Modeling (2016 workshop)
  - Focused on innovative **power-water linkages in models** to inform policy and other decision-making
  - Identified next steps, including exploring coupling between water and electricity sectors that increases flexibility to increase resilience

Questions?

Zachary Clement
Office of Energy Policy and Systems Analysis (EPSA)
Department of Energy
Zachary.clement@hq.doe.gov
(202) 586-7537

Diana J. Bauer, Ph.D.
Office of Energy Policy and Systems Analysis (EPSA)
Department of Energy
diana.bauer@hq.doe.gov
(202) 287-5773

DOE Energy-Water Nexus Crosscut Team:
http://www.energy.gov/under-secretary-science-and-energy/water-energy-tech-team

EPSA Energy-Water Initiative
http://energy.gov/epsa/energy-water-nexus